Mining logistics systems: classification, identification, innovation

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Annotation. The article presents a classification of existing and prospective mining logistics systems in the economy of the Russian Far East, designed to determine the directions of innovative processes in the field of technical and technological equipment of transport infrastructure, ensuring the effective functioning of these systems. The most significant branches of the regional economy for the formation of innovative mining and logistics systems are identified. Statistical (geographical) and evaluative (socio-organizational) classification features and their categories (classes) are proposed to identify the most economically significant mining and logistics systems in the region and make optimal management decisions to update the technical and technological equipment of transport and warehouse infrastructure facilities serving these systems.

1 Introduction

It is known that innovative activities are aimed at developing, creating, and distributing new types of equipment, technologies, organizational forms, and generating new organizational and economic relations. One of the organizational forms of economic activity that allows generating appropriate relationships is logistics systems (LS). In this connection, the great value has the classification of existing and promising LSs in the economy of the Russian Far East, designed to determine the directions of innovative processes in the field of technical and technological equipment of transport infrastructure [1-3] providing the effective functioning of these systems and to determine the most important industries for the formation of an innovative LS of the Far Eastern.

2 Theory and methods of research

Classification (“classification” is used in its second meaning, that is “the distribution of certain objects by classes or categories depending on their general characteristics”) of logistics systems (LS) is based on two main groups of features (classes):

a) *the first (statistical) group* - features that can be used to identify various statistical (quantitative) indicators: LS number in a particular sector of the economy, characterizing the volumes and structure of production in the sector; the number of LS that interact with a particular country, describing the development of foreign economic relations with the spec-

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ified country; etc. This does not reveal the level of economic or social preference of a particular class (category, type) over any other class of the same attribute, for example, it does not state the situation when, other things being equal, the LS interacting with Japan will be preferable to the LS associated with the Republic of Korea;

b) **the second (evaluative) group** - features in which classes (categories, types, groups, etc.) can be evaluated from rationality (value, utility) for various social formations and society as a whole, that is, markedly different in the level (degree) of such rationality. It should be noted that the splitting characteristic of LS on the level of rationality is the source for the classification used for the integral evaluation of drugs of some sectors of the economy of a region or country (in this case the mining industry of the Far East of the Russian Federation).

3 Results

In particular, the LS products of the mining industry of the Russian Far East can be classified according to the following statistical characteristics:

1. **Sectoral basis.** In this paper, the authors distinguish between the total classification of LS, classification of mining LS, classification of forest industry LS, etc.

2. **Functioning scale in the Russian Federation.** In principle, an LS can be created either by a regional economic organization or by a national economic organization (federal-level corporation).

3. **Region of the production function.** Regional LS can be divided according to the region of operation of production (mining, processing) to Far Eastern, East Siberian, West Siberian, etc.

4. **Mining or processing site.** This feature is essential for mining LS. The classification of Russian LS by the administrative territory of the Russian Far East, where mining or processing of mining resources is carried out, is quite trivial: Amur, Primorye, Khabarovsk, Sakhalin, etc.

5. **Relation to the Far East of the Russian Federation.** All LS related to the Russian Far East and considered in this paper must be divided into two groups: Russian and foreign.

6. **Region of consumers and suppliers.** The limits of the above-mentioned Russian and foreign LS may be limited to different regions and classified accordingly.

7. **Country of consumers or suppliers.** The classification of Russian **mining** LS by the country of residence of the respective consumers or suppliers is also quite trivial: Russian, Chinese, Japanese, South Korean, North Korean, etc.

8. **Type of transportation.** Depending on the use of one or more modes of transport for the transport of timber products, Russian LS can be divided into the following categories (classes): rail, road, sea, river, and mixed.

9. **Type of transport routes at border crossings.** Depending on the type of transport routes at border crossings used for transporting mining goods from the Russian Federation to other countries and back, Russian LS may be divided into the following categories (classes): rail, road, and mixed.

The classification of LS by the level of rationality is used for an integrated assessment of LS in any industry of the mining and processing sectors of the economy of a region or country (in this case, mining LS of the Russian Far East) and includes the following features and their classes:

1. **Subject of evaluating the LS rationality.** Mining LS can be classified depending on the subject(s) of determining the degree of rationality of their functioning: a) rational for the economic entity; b) rational for the consumer of goods or services; c) rational for the population of the territory where the company operates; d) rational for the state; e) rational for society. The integral criterion for such rationality of the LS is some compromise levels

of the first four criteria.

2. Relations with society and the state. According to the ways in which the LS is influenced by society and the state, as well as the degree to which the LS fulfills its obligations to society and the state, there are two alternative groups of LS: a) legal or official; b) illegal or unofficial.

Among the legal (official) LS are the following types: **market adjustable** - economic activity which is regulated by the state directly (conclusion of lease contracts for commercial use of mining areas, issuing one-time permits for mining, etc.) or indirectly (increase or decrease tax rates, licensing, etc.); **free market** - economic activity (extraction of mining resources, processing, sales, supply own activity) which is based on free competition and the full non-interference of the state and carried out in accordance with accepted laws and regulations; **combined** - based on the mixed form of ownership (public and private); **state** - material resources are state property and which operates in the market freely within the established higher authorities of management; **command** (centrally planned) - tangible resources which are state property, direction and coordination of economic activities are carried out by the state through central planning, management and control; **traditional** - economic system in which traditions and customs determine the practice of using mining resources (households, tribal craft). Each of the illegal (unofficial) LS is represented as a shadow system that conducts production, distribution, exchange, and consumption of mining resources that are not controlled by society. In this way, it carries out actions that are hidden from the state administration and the public and are committed to the self-serving personal and group interests of individual citizens and social groups. LS as a shadow system, in turn, is represented by several varieties in order of decreasing the degree of criminalization: *general; underground; latent; criminal; unofficial; fictitious; informal*.

3. Integration factor. Regarding the application of foreign economic relations, the LS is divided into two categories: **closed** - operating within the framework of the economic self-sufficiency; **open** - operating within the open economy.

4. Distribution of production factors. From rationality, it is very important to divide the Russian mining and processing industries by analogy with the fishing industry, depending on the number and composition of the location in the Far East of the Russian Federation of various combinations of facilities (production, operations) related to the four main types of economic activity, as factors of production placement: a) supply; b) raw materials extraction; c) raw materials processing; d) sales.

5. Limit distribution factors. Here it should be noted that the mining raw material is converted into an intermediate product by successive processing, and then into the final product. And following this it is customary to allocate four main divisions: 1) procurement; 2) physical; 3) chemical; 4) final. If we go back to the above factors of production placement, the procurement process is nothing more than mining raw materials, and the other processes are three types of processing of mining raw materials or mining semi-finished products. The last three types of processing as physical, chemical, and final processing can be placed both in the Far East of the Russian Federation and abroad in various variations.

Accordingly, the transferred Russian LS can be classified in the following positions: one-factor (physical; chemical; final; two-factor (physical-chemical; physical-final; chemical-final); three-factor complex.

6. Type of institutional structure. Russian LSs of all sectors of the economy (including mining LS) by the type (class, category) of the structure of legal form are arranged in the following order: single LS of the enterprise; parallel LS of the enterprise; single LS of the joint venture (JV); parallel LS of the JV; corporate LS; transactional LS.

7. Ownership of vehicles (rolling stock). Depending on the ownership of Russian or foreign companies of vehicles (rolling stock) that transport mining goods from the Russian Federation to other countries and back, they can be divided into the following categories

(classes): Russian, foreign [5, 6] and mixed.

8. **Type of cargo transshipment at border crossings.** Russian LS depending on the presence or absence of transshipment of goods (mining products), or rolling stock from one mode of transport in the rolling stock of another mode of transport or rolling stock from one country to the rolling stock of other countries can be divided into the following categories (classes): reloading and reloading-free.

9. **Period of operation of the border crossing.** Depending on the period of operation of the border crossing, Russian LS can be divided into the following categories (classes): year-round, intermittent (for changing the mode of transport), and seasonal.

4 Discussion

A significant part of the explored natural resources of the Russian Far East cannot be used since it is practically impossible to carry out effective economic operations: energy supply and delivery of necessary materials and equipment, extraction of natural resources, their transportation, processing and sale, that is, the formation of effective LS. To a greater extent, this applies to minerals, to a lesser extent to plant and aquatic bioresources [4]. However, today the extractive industries – oil and gas, coal, non-ferrous metallurgy, forestry, and fishing - are the most competitive among the economic sectors of the Russian Far East. These industries can contribute to the further development of transport in the Russian Far East, as they are very attractive for foreign and domestic investors and are very promising for the formation of a transport system.

In addition to these circumstances, one must consider the significant degree of government involvement and other challenges for private business in the formation of LS in the fields of oil, gas and coal industry and nonferrous metallurgy (the need for inter-state agreements, the specific difficulties of obtaining licenses for development of fields, construction of highly capital intensive facilities, the oligopoly nature of the market proposals, the uniqueness of the international environment in the consumer market of minerals, etc.).

5 Conclusions

Thus, the proposed statistical (geographical) and evaluative (socio-organizational) classification features and their categories (classes) allow to identify the most economically significant mining facilities in the region and make optimal management decisions to update the technical and technological equipment of transport and warehouse infrastructure facilities serving these systems.

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